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Gneiss Formation
Limestone Formation
Primitive Clayslate Formation
Eurite Formation
Transition Formation
Serpentine Formation

REFERENCES.
County Lines
Township Lines
Turnpike Roads
Common Roads
Manufactory
Meeting House
Mill

MAP
of
PHILADELPHIA
AND
ADJACENT COUNTRY.

Designed to illustr the Geologi
cal Survey mad

Scale
5 Miles

Longitude East from Washington.

1°40'

1°50'

40°

Gneiss Formation
Limestone Formation
Primitive Clayslate Formation
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REFERENCES.
County Lines
Township Lines
Turnpike Roads
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Manufactory
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Mill

Dam
Swedes Ford
PLYMOUTH
WHITPAINE
GWYNEDD
UPPER MERION
TREDYFFRIN
EASTOWN
Spread Eagle
UPPER DUBLIN
HORSHAM
MONTGOMERY
WHITEMARSH
Sandy Run
Fraser
Castle Rock
NEWTOWN Square
LOWER MERION
Flour T.
SPRINGFIELD
Willow Grove
Guinea Town
Buck T.
EDGMONT
Chesnut Hill
Mill Creek
Abington
ABINGTON
Dam
Flat Rock D.
Mount Airy
Mount Pleasant
Jenkintown
Haines
Levering
Price Clapier
Smithfield
MORELAND
Fox Chase
Butler
Nice T.
Falls
Haddington
Wynnefield
Lansdown
Belmont
Jones
Bradley
Smith
Sutrille
Fisher
Brick
Solitude
Dam
Hamilton
Mantua
Darby
Blue Bell
Horn Town
Ridley Creek
Crum Creek
Chester Cr.
CHESTER
Darby Creek
Gibbs Creek
Eyre
Mt. Calmont
Bustleton
Pennypack Creek
Holmesburg
Andalusia
Frankford
Frankford Cr.
Arsenal
Point No Point
Hall T.
Richmond
Kensington
Penn's L.
Lazaretto
Tinicum Island
Tinicum
Ferry
Jones I.
Ft Mifflin
Mud I.
L. Mud I.
Hog I.
Darby Creek
Navy Yard
DELAWARE RIVER

Scale.
½ ½ ¾ 1 2 4 6 Miles.

A MAP
of
PHILADELPHIA
AND
ADJACENT COUNTRY;

Designed to illustr[ate] the Geologi[cal] Survey made [by] W. Trost.

40°

Joseph Warner

GEOLOGICAL

SURVEY

OF THE

ENVIRONS OF PHILADELPHIA:

PERFORMED BY ORDER OF THE

Philadelphia Society for promoting Agriculture.

BY

G. TROOST, M.D.

PHILADELPHIA:

PUBLISHED BY H. S. TANNER, 177 CHESNUT STREET.

Clark & Raser, Printers, 33 Carter's Alley.

1826.

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Philadelphia, January 16th, 1826.

GENTLEMEN,

If we consider that the first geologist of which Europe can boast,* employed twelve years and upwards, during the prime of his scientific life, in the construction of a geological map of the mining district (Ertzgeberge) of Saxony, which has never yet been published—that upwards of 80 officers of mines have been employed, since the commencement of the French revolution, and have not yet been able to offer a geological map of that country to the world; then I hope that the necessary imperfections existing in the Geological Survey and Map which I now lay before the Agricultural Society, will be received with that indulgence which an attempt to perform so arduous an undertaking requires.—I offer it therefore solely as an attempt to delineate the geological positions of our environs, and to give some general ideas of the nature and chemical constituents of the soil.—That it may as such, merit the approbation of the Society and the public, is the wish of

Your obedient servant,

GERHARD. TROOST.

To the Philadelphia Society for promoting Agriculture.

* Werner, Professor at Freyberg, Saxony.

16852

GEOLOGICAL SURVEY,

&c.

THAT part of Pennsylvania forming a semicircle, or segment of a circle, whereof the centre is the Rotunda in High street, Philadelphia, and the radii extend fifteen miles, bounded on the east by the river Delaware, belongs to the primordial formation. Philadelphia is placed on an alluvion, which covers this formation between the river Delaware and Schuylkill, two or three miles to the north of the junction of the latter with the Delaware. It is near this city on the Schuylkill, that the rocks belonging to the gneiss formation project above this alluvion, and extend from the Upper Ferry, to about nine miles up the Schuylkill. This gneiss, which contains here and there, some subordinate formations, runs in a direction generally from north-east to south-west. The subordinate formations of this gneiss are the *diabase* (1) and the *pegmatite* (2), in which sometimes the feldspar occurs of an earthy appearance or *kaolin* (3), being abundantly intersected by veins, or properly speaking strata of *eurite* (4). This gneiss is what is generally called common gneiss, in which the feldspar predominates, and is intersected by veins of pegmatite. I met with a stratum near Lemon Hill, a few rods to the north of the New Water Works, where the feldspar is in a state of kaolin. This rock is in some places very abun-

dant, particularly in the vicinity of Germantown, where it occurs in nests and veins, in the form of graphic granite, of which we find here and there instances, particularly to the west of Germantown. The boulders which we find to the east of the same place, belong to the same kind of granite, but is not the graphic granite. Properly speaking, these contain the accidental intermixtures of beryl and tourmaline. The eurite does not exist in large subordinate formations in this gneiss, but only in narrow bands or veins, of which I found a small stratum of upwards of two inches, between Philadelphia and Frankford, in a gneiss which is passing into diabase. This last mentioned mineral constitutes one of the principal subordinate formations in the gneiss. As soon as we cross the gneiss near the Water Works, where it is rather homogeneous, we see the amphibole make its appearance, forming a mixed rock of compact feldspar, black mica and amphibole, exhibiting a passage of the gneiss into diabase, which soon becomes the true diabase; of this we find several quarries, one or one and a half miles to the north and north-west of the city, as at Mount Prospect, &c. This diabase is not what is called a formation, but a subordinate bank; it exhibits different varieties of diabase rocks, as the granatoide diabase, which is generally quarried in this vicinity to construct turnpike roads, and gives rise to that ochrey dust which makes the roads in the vicinity of Philadelphia so disagreeable in dry summers. The schistose diabase occurs in the same subordinate bank, particularly in a north-west direction from Germantown, and is quarried there for building stone. It abounds also to the west of the Schuylkill, particularly in Darby township, Delaware county. We meet also a variety of diabase, which I do not recollect to have

been described, and which I will call porphyro-lenticular diabase. It is of a fine grained structure, forming nearly a homogeneous paste, containing oval glands of lamellar feldspar of a reddish gray colour. This rock is more common on the west side of the Schuylkill, than on the east, where I found it only in detached pieces. All these varieties, intermixed sometimes with gneiss containing scarcely any mica, sometimes with gneiss in which the mica abounds and approaching to mica slate, sometimes intersected with veins of eurite, continue through the gneiss, till we pass the Falls of Schuylkill, where we meet with the homogeneous gneiss of a solid texture, similar to that at the upper bridge, where it is quarried for building purposes. Near to the junction of the Wissahiccon creek and the Schuylkill, the rock changes in its nature, the feldspar becomes now scarce, and the quartz takes its place; at the same time the mica becomes more abundant, and the rock is now a true mica slate, abounding in garnets, staurotides, occasionally cyanite, and red oxide of titanium. This rock, which I have not been able to ascertain whether it is a distinct formation, or only subordinate to the gneiss, comprehends nearly the same subordinate strata, as the gneiss which we have been describing. We find again abundance of granitoid diabase near the Flat Rock, containing there some chlorite talc, and near Livezly's mill, where this rock is intermediate between diabase and gneiss, exhibiting there undulating strata, in which is made a large excavation by a person who expected to find silver, being misled by those waving strata resembling somewhat an inverted s, thus ς, which in his opinion signified silver. On the mill near the dwelling of the same Mr. Livezly, occurs another amphibolic rock, which is the asbestiforme actinolite. The rocks begin

there to partake of a talcose nature: more northwardly, we find the chlorite talc (chloritic steaschiste), containing crystals of octahedral iron ore, and some slaty rocks belonging to the philade, approaching the talcose slate: these rocks form subordinate banks, veins or nests to the subsequent, or magnesian, or talc formation, which continues to near Spring Mill on the Schuylkill, and below where the Chesnut Hill road crosses the Wissahiccon creek.

In the vicinity of these places, the rocks change entirely, and we meet now the talcose or serpentine formation, which contains again some subordinate rocks. The serpentine, *ophiolite* (5), is generally of a dark green, approaching to a black colour. It is in this formation, that the *steatitose steaschiste* (6), which is used in Philadelphia under the name of soapstone, for the construction of fire-places, is quarried. A fine subordinate stratum of this rock, crosses the Schuylkill upwards of $1\frac{1}{2}$ or 2 miles above the Flat Rock bridge. This steatitose steachiste contains as accidental intermixtures, nodules of magnesian calcareous spar, sometimes crystallized, and beautiful chloritic steachiste. The stratum which is quarried at the abovementioned place, is pretty extensive, and seems to pass into what geologists call ophiolin steaschiste, forming a beautiful rock of a gray colour, with black round spots, which projects above ground, nearly half a mile below where the Chesnut Hill road crosses the Wissahiccon near Spruce's Mill. This rock being of the same nature as that which is commonly called soapstone, would perhaps answer the same purpose, and when sawed, would be more ornamental than the common soapstone. Besides this, the serpentine contains also nests and strata of the chloritic steaschiste, and those intermixtures which generally characterize

this formation, and which constitute what geologists call *ferriferous ophiolite, chromiferous ophiolite, and garnatic ophiolite,* all which occur on both sides of the Schuylkill. After this formation, which finishes below Spring Mill, another makes its appearance, viz. the primitive clayslate formation.

This formation is well characterized on the west side of the Schuylkill, constituting the high ridge which separates the limestone from the granitic rocks. These rocks, which I suppose to be a distinct formation, comprehend several varieties of slaty rocks, as the primitive clayslate, philade, which forms the chief mass, and which passes into talcose slate, and sometimes into chlorite slate, containing masses of earthy chlorite and much quartz. A fine structure of these rocks is exhibited on the place called the Gulf, where the waters, which perhaps once, filled the valley to the south of the ridge, forced a passage through it. As subordinate strata, we find several beds of the brown iron stone which passes sometimes into brown hematite of which a few mines are now opened, as near Spring Mill and the Gulf. I found traces of this ore in several places, in this formation, particularly between the Gulf and Anderson's marble quarry.

The north side of the above described ridge being moderately steep, forms one of the sides of the limestone valley; but before we reach this formation, we find another small formation, which is the eúritic (*weistein of Werner*).

I was much delighted at meeting this rock for the first time on this side of the Atlantic.—I imagined myself transported to the Ertzgeberge in Saxony, and remembered with renewed pleasure the father of geology, who made us acquainted with it.

The eurite or white stone in this formation, is in every

respect similar to that of Pennig on the Ertzgeberge in Saxony; it seems to produce a distinct formation, and separates the clayslate from the primitive limestone formation. It makes its first appearance at Spring Mill, where the road is cut through it near the little rivulet; projecting in a north east direction it forms the barren hills, and crosses the Germantown road.—It belongs to the schistose eurite (slaty white stone of Werner) and breaks often in rhomboidal pieces, which have been mistaken for crystalline cleavages; but this cannot be the case, the angles varying nearly in every rhombe. It seems to be posterior in formation to the European white stone, resting here on the primitive slate, and being covered by primitive limestone, which is one of the younger in the series of the primitive rocks.

The glistening particles which this *eurite* contains, seem to be talc, and not mica, and mixed with the feldspatic rock in various proportions. If we trace it from Spring Mill, where it is in its most perfect state, containing a few minute garnets, along the barren hills, we find it passing, yet in its perfect state, the Germantown road, but there also we find in the same a variety of talc (*micrite*) which in my opinion is the same rock now under examination, in which the feldspar has disappeared, the talc having preserved its slaty structure, which is now easily destroyed by the least friction of the fingers. The rocks which we find to the south of the barren hills, seem to belong to the same eurite, but have a reddish colour, and are approaching to the gneiss, being not so slaty, and containing more mica, than those of the barren hills.

This euritic formation is covered by the limestone formation, which composes the interesting limestone valley, and which furnishes us with the marble that embellishes our city.

It is generally composed of granular limestone, through which different strata of marble run, which is quarried in various places for building purposes, containing veins of cipolin (a granular limestone, and this latter containing veins of micaceous green talc) which characterize the marble used in Philadelphia, and some black slaty lamina, composed of clay and limestone, coloured perhaps by some coally matter. We did not find any strata, properly called subordinate in this formation; but discovered occasionally the same pierced by the diabase rocks, which we have reason to believe to be ramifications belonging to the above described formations. This rock makes its appearance in the limestone formation near the place of Mr. Jones, at Spring Mill. This formation is the last we meet here of the primordial formations, and is covered by the transition rocks, of which, nevertheless, we do not find any vestiges on the Schuylkill, on this side of Norristown, below which place is the limit of our researches, but more to the east we find it covered by transition rocks. It is the same on the west side of this river, near the Swedes ford, but as far as the Swedish church no rocks project above the soil: it is there only by digging that the limestone is found. Upwards of $1\frac{1}{2}$ mile below the Swedish ford, a few singular hills make their appearance. They are of a hemispheric form, and are composed of a homogeneous milky quartz, having nearly no soil, or only here and there a thin covering. I have not been able to ascertain whether these quartz hills constitute a distinct formation, or whether they are subordinate to the primitive clayslate formation, with which they are in immediate contact. I did not find any mineral substance in it, and the quartz is handsome and white.

The north eastern part of our semicircle penetrates more

into the transition formation. The limestone valley, which at Plymouth and the upper part of Whitemarsh townships crosses the Schuylkill, and runs in an east-north-east direction, is bordered on the north-west by a transition through which, in the townships of Gwinedd, and part of Upper Dublin, the Wissahiccon creek runs. The edge of this transition formation, we trace from Whitpain, Upper Dublin, where the limestone, upwards of two miles to the west of Willow Grove, sinks under the transition and appears one, or one and a half miles to the east of the same place in Bucks County again, though only in small quantities above ground, and is soon lost entirely.

The transition rocks in the above place are particularly the graywacke, graywacke slate, and transition diabase, sometimes intermixed with talc. These transition rocks are particularly characterized by a bluish greasy quartz, which sometimes passes into reddish or milky white, and are here and there intersected with veins of variegated sandstone, and brown ironstone. These rocks extend as far as the limit of our survey. Near Willow Grove and Hatborough, the primitive seems to pierce again through the limestone and transition, which contains much talc and tourmaline, and is perhaps a ramification of the primitive slate formation. The tourmaline is in these rocks sometimes so abundant, as to form homogeneous perfect black masses, which are striated, and sometimes of a granular structure. Perhaps similar masses have induced some to search in the vicinity of Willow Grove for coal, as persons have actually been boring, and lost upwards of 15 feet of an auger, which is yet in one of the holes. This shows a want of geological knowledge in the undertaker, it being known even to the farmers in the vicinity of Willow

Grove, that by digging upwards of twenty feet they have passed the superincumbent stratum, and then met limestone similar to that of Whitemarsh and Bucks County, which, as we have stated, is primitive limestone, in which neither anthracite nor bituminous coal occur. In the boulders of the primitive rocks in the vicinity of Willow Grove, sometimes zircon, titanium and oligist iron is found in small quantities.

Such are the different rocks which compose that part of Pennsylvania, which it was the desire of the Society to have described. Having ascertained that the rocks of the west side of the Schuylkill are similar to those which we have described on the east side, we shall not enter into a repetition by reviewing the same rocks, but shall only endeavour to trace them on the west side of that river, before we investigate what influence the different rocks have in the composition of the various soils.

As has been already mentioned, the formations which we have been describing, run pretty much in a direction from north-east to south-west, and nearly all parallel to one another; a few erring ramifications, and partial formations, excepted, with which we will become better acquainted in describing the different soils of the various townships.

The gneiss formation, which is the oldest of the rocks occurring in our vicinity, loses itself to the south-east, under a cover of alluvion through which the Delaware river runs. It continues from thence to the north-west, in the manner we have been describing on the Schuylkill, and Wissahiccon creek; changing sometimes to diabase, mica slate, and some other varieties of these rocks, as we have seen on the above mentioned rivers, with only some slight deviations, till it reaches the serpentine formation, which not being so much covered

as the former, can be traced nearly uninterrupted from near Chesnut Hill, where it first appears above the soil, to where it passes to the south-east of West Chester, and crosses the Susquehanna at the Bald Friars, running through Hartford County, Maryland, to 9 miles north-west of Baltimore, forming the bare hills, &c.

In that part of Pennsylvania which we are describing, the serpentine formation first appears between the 10 and 11 mile stone, on the road to Chesnut Hill, and thence extends to the north-east, and crossing the Wissahiccon, at Spruce's mill, and the Ridge road, at the 10 mile stone, passes over the Schuylkill, where the rock, known by the name of soapstone, on the east and west side of that river is quarried: it thence runs in a south-west course, through Lower Merion township, where it is covered again, and is visible in large masses near Amies' paper mill, on Mill Creek; going from thence in a west-north-west direction, it projects again above ground in Tredyffin township, Chester County, in a field near the 15th mile stone on the turnpike road, and then running south-west it is again visible to the south-east of West Chester. This formation shoots out between two and three miles to the west of the Schuylkill; a branch running in a south-west direction, and appearing above ground near the Yellow Spring, on the farm of Mr. Lewis on the West Chester road, where the serpentine abounds in chromiferous iron; it thence proceeds to the Blue Hill schoolhouse in Upper Providence, joining perhaps again with the main stratum.

The other strata which I have been describing, running as far as I have been able to ascertain, all parallel to one another, and to the serpentine, it would be a mere repetition of what I have been saying respecting the serpentine formation,

f we would describe the directions in which these strata run; [refer therefore to what I have stated in regard to the serpentine, for the directions which the other formations take.

DESCRIPTION OF SOIL.

In the very numerous excursions which I performed in different directions through the space allotted for my examination, I have often witnessed that the rocks do not always influence the nature of the soil which covers them. I found that rocks from the decomposition of which I expected to find a fertile soil, were covered with sterile micaceous sand; and those which I expected to find covered by a sterile soil, produced a luxuriant vegetation. It is known, for instance, that the soil produced by the decomposition of the magnesian rocks, such as the serpentine and talc, is barren; nevertheless the crops which are raised in the vicinity of the soapstone quarry in Roxborough, near the Schuylkill, are good. Again, the soil produced by the decomposition of the amphibolic rocks is generally good, and well adapted for the cultivation of wheat, yet we have seen in some parts of Lower Dublin and Abingdon, these rocks covered by a light micaceous sandy soil, on which the labour of the farmer was nearly all lost. We found in general that it was the subsoil which characterized the fertility or the barrenness of the ground, and not always the rocks which are below. This remark nevertheless does not hold good in extensive formations, particularly the limestone formation. There, not only the soil, covering these rocks partake of the beneficial influence of the lime on vegetation, but also of the adjacent soil which covers other rocks.

Let us now examine the soils of the different townships

which compose the semicircle, and commence with one in which generally the amphibolic rocks prevail, and where the soil seems to have been partially produced by the decomposition of these rocks.

The soil of Oxford township is, for the greater part, of a stiff loamy nature; the subsoil is of a stiff yellow loam, bordering on clay. This stratum of subsoil is from 4 to 6 feet thick, the upper soil when properly cultivated produces fine hay and barley, but it requires more manure than some of the adjacent townships. At the farms of Messrs. Caster and S. Fox, we see what good management can produce. The farm of S. Fox, which is nearly in the centre of the township, and is somewhat intermediate between the best and poorest soils of that township, is what is generally called a stiff cold soil; it is nevertheless one of the best farms in that vicinity. Mr. Fox generally manures his ground with stable manure, and the refuse dung of the white lead factories, sometimes with a little lime. He has now brought his farm to such perfection, that he raises upon an average, through good and bad years, two tons of hay per acre, 35 bushels of wheat, 55 to 60 bushels of corn, and 35 to 40 bushels of barley. He uses occasionally some gypsum for his grass, which he finds beneficial. Such soil prevails generally in this township, in which are excellent farms. In some places, nevertheless, the soils are of a lighter nature. Near the Volunteer tavern, the soil is more sandy; it changes also going to the Delaware river; the soil between the Arsenal and the turnpike road, is better than the interior of the township; it is a rich loam, not so stiff and cold as that of the interior, and contains some excellent farms. The soil becomes more sandy approaching the river, where it is gravelly.

With this description coincides that of the cultivated part of the Northern Liberties of Philadelphia—sandy along the river Delaware, and more firm and loamy in the upper part; possessing an extensive bed of clayey loam for subsoil, which in some parts produces good brick and potter's clay: these prevail under the greatest part of Philadelphia, where they rest on a bed of gravel.

The soil of Roxborough is generally of a lighter nature; and in this the manure is soon lost. I expected nevertheless, to find much difference in the soil which covers the serpentine formation, in the vicinity of the soapstone quarry; but it appears that they obtain the same quantity of grain off it, as off the other parts of the township.

Part of the soil of White Marsh township is of a light sandy loamy nature, and the produce is similar to those of the above described townships; but the upper part of it, in which the limestone prevails, is of a different nature,—being a fine level country, possessing an excellent soil, well calculated for the growth of grass and grain. The upper part of White Marsh, Plymouth, part of Whitpain, and part of Upper Dublin, partake of the same nature, and constitute the limestone valley. The limestone rocks are sometimes only thinly covered with soil, which is every where very fertile. Some of it produces upwards of 3 tons of hay per acre, but the average is 2 tons of hay, 32 bushels of wheat, 40 to 50 bushels of corn, 80 bushels of oats, and 25 of rye; so that the produce of grain differs not materially, from that raised on the good farms of Oxford and Byberry townships.

The soils of Springfield, Cheltenham, and Abingdon, coincide with those of Moreland and Upper Dublin.

Lower Dublin township possesses a soil which is less

clayey, and more varied, than the above described townships. The south partakes of the nature of Oxford, and the north of Moreland and Byberry townships, but the centre is very much varied, being generally of a light loamy nature, intermixed here and there, with some sandy and barren spots. Through the middle of this township runs the Pennepack creek, in a direction of north-west to south-east, falling near Holmesburg, into the Delaware river. The banks of this little stream are at some places bold and romantic, rising upwards of 60 to 70 feet nearly vertical above the creek, while at other places the banks are flat. From its commencement in Horsham township, Montgomery county, it supplies 16 mills, which often are obliged to stop for want of water. The rocks prevailing on this creek, are the same as those of the Wissahiccon, to which this creek has some resemblance. They are generally composed of gneiss, passing here and there into mica slate and diabase, intermixed with the minerals which I found in these formations, as garnet, kaolin, staurotide, &c.

We meet on the borders of this creek some fine spots of ground. I examined with satisfaction the farm of Mr. Poll, situated near the bridge on the road going from the Fox Chase to Huntingdon, to the north or north-east side of the road. This farmer has certainly taken every possible advantage of the ground he inhabits; and of a marshy and neglected spot, which it was perhaps 15 or 20 years ago, he has made one of the best farms in the vicinity. It is in the highest state of cultivation. The generality of this soil does not require as much manure, as the soil of Oxford. Mr. Poll raises on an average, $1\frac{1}{2}$ tons of hay, 25 to 30 bushels of wheat, and 45 to 50 bushels of corn per acre. He planted this year (1822) a

spot of ¾ of an acre, or 119 poles, with potatoes—it was the lower part of a rich spot of ground situated near a fish pond, and having well manured it, he raised the amazing quantity of 310 bushels of fine potatoes, while on other farms the plants died from want of rain. It is true, if it had been a wet season, the whole of his crop would have been lost.

He found the culture of ruta baga very beneficial for cattle, and raised upwards of 300 bushels per acre.

A great contrast with this farm is to be seen in that of Mr. Taylor, being only separated from that of Mr. Poll by the above mentioned road. The soil of this farm is very sandy, approaching here and there to barren. The rocks there, near the Pennepack, are amphibolic; and we have here an instance of the rocks, on which the soil rests, not always influencing its nature. On the opposite bank, where the land is not so high, we find again a good soil: Mr. James Fenton, who has almost every variety of soil on his farm, raises upwards of 25 to 30 bushels of corn, 15 to 20 bushels of rye, and from one to one and a half ton of hay per acre. The description of these three farms, corresponds with the nature of nearly all the land, through which the Pennypack creek runs. Leaving the creek, the ground becomes more level, and of a stiffer nature, which nevertheless, when we approach the Delaware river, becomes light and gravelly. The lands near this river are sandy, well calculated for buckwheat and rye; a few spots answer nevertheless perfectly well for wheat and barley. The farm of Nathan Spencer, which is situated on the mouth of the Poquessin creek, contains numerous varieties of soil, being sandy near the river, then gravelly, afterwards loamy, having here and there some veins of clayey ground, and some spots of micaceous sand. In general, the

subsoil extending from the Poquessin to the Pennypack creek, prevails nearly through the whole of the eastern part of this township, and is a stiff sandy clay, which fits it for retaining manure. The produce of the farms in general, of that part of the township, are from 20 to 30 bushels of wheat, 40 bushels of corn, 30 bushels of buckwheat, 20 to 25 bushels of rye; 30 to 35 bushels of oats, and from one to one and a half ton of hay per acre. Some spots in this township are remarkable for the quantity of hay which is raised from them, particularly those bordering the Delaware river. Mr. Phillips has a spot which produces upwards of three tons of hay to the acre. This gentleman finds great benefit from ploughing and digging very deep (upwards of 12 inches), a practice which is not generally approved of by other farmers. He manures his ground with a variety of reeds from the river shore, particularly from the opposite New Jersey side, from which he takes sometimes in one year upwards of 1300 loads; these he puts in his barn-yard, where they rot in the course of two or three months, and then form excellent manure: he cures also some of them with salt, and makes a wholesome food for cows.

In the same township, to the north of Holmesburg, I found a field with Palma Christi, or castor bean, belonging to Benjamin Forrester in Holmesburg; the plants did not thrive very well, not being higher than between one and a half and two feet. Mr. F. told me, that it nevertheless proved to be a profitable crop, yielding generally from 25 to 30 bushels of the castor oil seed per acre. As our winters seem to become from year to year milder, and of course better adapted for this plant, we would recommend the farmers to pay some attention to the culture of this article.

The soil of Moreland township, which is generally level, is of a rather lighter nature than that of Dublin township. Manure produces more effect than in the former. This soil, which is a light sandy loam, produces at the farm of Mr. Jacob Summers, with which the generality of the soil of that township coincides, on an average, 20 bushels of wheat per acre, 25 to 30 bushels of corn, and one ton of hay. The bottom lands are generally of a blue stiff loam, and are better adapted for grass, giving on an average $2\frac{1}{2}$ tons per acre. This blue loam I found in several spots, to form the subsoil for the higher grounds. We are here still on the gneiss formation, containing the subordinate strata as has been described. The amphibolic rocks project above ground to the west of Smithfield, and going more north, we meet in the northern part of Byberry township, near the commencement of the Poquessin creek, the mica slate, which there, on the road to Newtown, and in some other places westward, in that township, is quarried for buildings.

Byberry is a fine level township, and the soil has much similarity with that of Moreland; that is, of a light sandy loam. The soil for cultivation is generally in this township from 7 to 8 inches deep, lying on a stiff loamy subsoil, of from 4 to 6 feet deep. The farm of Mr. Benjamin Walmsly, which is in an excellent state of cultivation, situated nearly in the centre of the township, near the Friends' meeting house, produces on an average of 15 years, 20 bushels of wheat per acre—and he has raised 3 tons of hay on the same quantity of land; but I found the average of the whole township not exceeding 2 tons per acre. Mr. Walmsly raised as much as 50 bushels of oats, but the average of the township produces only 35 bushels per acre. The lands in this township,

though on the whole fertile, do not seem so well adapted for winter, as for summer grain. The northern extremity of this township has not such good soil, and seems to contain more of the constituent parts of the mica slate, which as we have seen, pierces through the soil near the Newtown road.

From the Poquessin creek, Bucks county side, to the Bristol road, the soil is much the same as that which has been described, except near the Red Lion tavern on the creek, where the ground is more broken, and gneiss appears above the soil. On the south-east side of the Bristol road, the soil begins to assume a quite different aspect. All along the Delaware river, upwards of $\frac{1}{4}$ of a mile from its banks, there runs a vein of gravel, which is not formed by the disintegration of the circumjacent rocks, but containing flint and other fragments foreign to our formation, and must have been brought there by the river. Between this vein and the river, is a finer alluvial or sandy soil. No rock appears between the vein of gravel just mentioned, and the river. Near the place of Dr. Rousseau, upwards of half a mile from the river, the mica slate appears, and is quarried there. At the place of the above-mentioned gentleman, where we find a good specimen of the generality of the soil of these environs, the ground is composed of 6 feet of a light loose sandy loam,

2 do. red coarse gravel.
2 do. white do.
2 do. sand.

The doctor raises on this light ground by good management, on an average, from 35 to 40 bushels of corn per acre, 30 bushels of oats, and 2 tons of hay. He finds lime very beneficial for this light soil, and uses from 25 to 30 bushels per acre.

Mr. Thomas, in the neck of Poquessin creek, where the soil is also sandy and gravelly, raises upwards of 20 bushels of wheat per acre; from 15 to 20 bushels of rye, and 2 tons of clover: its soil is not well calculated to raise other kinds of grass.

Penn township contains a variety of soil. From the Upper Bridge of the Schuylkill to the place of Mr. James Fisher, the soil is very gravelly and sandy, having no good subsoil, and seems to be composed from the disintegration of the micaceous rocks. This kind of soil continues as long as the gneiss is the predominant rock. At Fountain Green and Rockland, the amphibolic rock begins to predominate, and the soil offers now another aspect. The country seats of Messrs. Biddle and Jones, possess a good loamy soil, having a clayey loam for undersoil. This kind of soil becomes rather better when we approach the Ridge road, and continues with some little variations till above the Robin Hood tavern, becoming more sandy again, and partaking of the micaceous nature to the north-east of that township.

Germantown township offers a great variety of soils. In the southern extremity, at the place of Mr. Logan, the soil is in general a stiff loam, notwithstanding the micaceous and quartzoze rocks which are on his premises. This loam is between three and four feet deep, resting on a stratum of 8 feet of gravel, under which lies a soft pegmatite containing kaolin of 7 feet thick, which covers the gneiss. In the vicinity of Germantown, the soil is of a lighter nature, containing micaceous sand, having in some spots a subsoil of clay, producing good crops and holding manure. The bottom lands have in general a clayey soil. Behind the place of Mr. Reuben Haines, I found in a pegmatite, the cyanite, and near

the bridge, crossing a branch of (I believe) the Wingdhoe-king creek, is a variety of amphibole, which some mineralogist thought was yenite.

In the foregoing pages I have given a description of the nature of the soil of Oxford, Northern Liberties, Upper and Lower Dublin, Moreland, Byberry, part of Bensalem, Penn, Roxborough, Germantown, Bristol, Cheltenham, Springfield, Abingdon, White Marsh, Plymouth and part of Whitepain (called generally by the inhabitants Wippen) townships, composing the country inclosed by the east side of the Schuylkill, and the Delaware rivers; and will now proceed in examining the soil to the west of the Schuylkill, which having the same origin, (the rocks being of the same nature as on the eastern side of the river,) have much similarity to the soil already described. I will therefore, to avoid repetitions, after having stated some particulars, compare these with the foregoing townships.

In Blockley township a sandy loam prevails, which is in some places pretty stiff, and apt to throw out the grain during winter, or what is generally called of a "spewing" nature. The centre of that township is, at some places, even clayey. The farmers here pay more attention to grazing, than raising grain. Mr. Edward George, whose farm partakes of the nature of the generality in the township, raises on an average 2 tons of hay per acre, and 40 bushels of corn. Towards the Schuylkill, the soil becomes more light, and partakes of the nature of the soil produced by the disintegration of the amphibolic rocks. At the highest point of this vicinity at Belmont, the seat of Judge Peters, the amphibole is covered only by the disintegrated parts of the same rock, and the soil is evidently partly formed by its decomposition. Not

far from the house of Judge Peters a quarry is opened of a very homogeneous compact diabase of a slaty texture, containing in its fissures some minute crystals of chlorite talc, as is the case on the eastern banks of the river. On the same place of Mr. Peters, we find this diabase passing into gneiss, mica slate, and pegmatite, containing abundance of kaolin. Judge Peters went through a bed of this kaolin, from 12 to 15 feet in thickness. The water which filters perhaps through a diabase rock, forms a spring of chalybeate water not far from his dwelling.

Judge Peters raises generally from one of his fields 25 bushels of wheat per acre; from another, which seems to partake more of the micaceous nature, he raises on an average 20 bushels of wheat.

Lower Merion has a soil very much the same as Blockley, though more light and sandy on the high grounds, which in some places approach to barren. The average of crop on the best farms is from 20 to 25 bushels of wheat per acre, 2 tons of hay, 30 bushels of rye, and 50 bushels of corn. There runs a strip of a very stiff soil through this township, projecting from Delaware county, passing the Schuylkill above the Flat Rock, to the south of the serpentine formation towards Chesnut Hill. It is very probable that this strip influences the soil, which covers there the magnesian rocks, it being seldom that they produce such good crops, as those raised here near the soapstone quarries.

The soils of Haverford and the upper part of Radnor townships, have much similarity with that of Lower Merion. Near the Buck tavern, the soil is not so fertile as to the north and north-west. The micaceous rocks, which influence the soil, prevail here. Towards the Spread Eagle, it is

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the amphibolic rocks which influence the soil, and is more tenacious. The average of crops in the vicinity of the Buck tavern, is 20 bushels of wheat, 25 bushels of spring barley, and $1\frac{1}{2}$ tons of hay per acre. The soil here, being of a light loam, is not much of a "spewing" nature, an occurrence which nevertheless will happen with clover.

The soil of Mr. Elliot's place is rather better than the former, and all the vicinity of Mill creek, except near Amies' paper mill, where the serpentine influences very much the soil, the ground is not of a "spewing" nature. The rocks which occur there are gneiss, and are called there sandstone. Mr. Elliot finds lime, as a manure, very beneficial upon every variety of soil in his vicinity. His crops average from 30 to 35 bushels of corn—he raised once 60 bushels per acre, $1\frac{1}{2}$ to 2 tons of hay. He finds millet a profitable crop.

A remarkably rich and fertile strip of land, of a brownish colour, runs through this township—it crosses the Schuylkill at Plymouth, extending towards the Spread Eagle tavern, where it crosses the turnpike road. Lime is used there with very good effect.

The lower or southerly part, and the centre of Radnor township, is quite of a different nature. Though very hilly, it contains excellent farms, and perhaps the best soil of the places I have examined, in this survey. In general the amphibolic rocks prevail here on the fertile grounds. Benjamin Davis, whose farm is somewhat in the centre of this township, raises on an average 25 to 30 bushels of wheat per acre, 40 bushels of corn, 50 bushels of oats, and $1\frac{1}{2}$ tons of hay. In this township we find another instance of rocks influencing the composition of the soil. A small rivulet, I believe a branch of Darby creek, separates here the amphibole from

the micaceous quartzose rocks; it is also the same run which separates two soils of a quite different nature. The one which covers the amphibole is a kind of loamy soil, recompensing highly the labour of the farmer; the other, which covers the micaceous rocks, and only separated by an insignificant rivulet, is a poor ungrateful soil, on which nearly all the labour of the cultivator is lost, and the manure soon disappears.

The townships of Chester, Springfield, Ridley, Tinicum and Kingsessing, have much similarity with the townships composing the north-eastern part of our semicircle, the description of which is applicable to these townships. The lower part along the Delaware river is composed of an alluvion, which is well calculated for grazing and growing hay. It contains a great number of low marshy situations, and no more grain is raised than is sufficient for their own consumption. The average of hay is upwards of 2 tons per acre, and 40 bushels of corn. The upper part of Kingsessing is a sandy loam, similar to that of Blockley, and very sandy towards Hamilton village, and the Schuylkill. Darby, Ridley, Springfield, Chester and Tinicum, possess a light sandy loam, in which the mica and quartzose rocks prevail, and generally possess a good subsoil, which causes some parts to receive great benefit from the improvements which are now generally applied, particularly the use of lime. At Springfield, the soil is remarkably sandy from the Springfield meeting house to the turnpike road. Lower Darby possesses some good soil, though of a light sandy nature; the rocks are gneiss, and near Darby mica slate: it contains, as at Springfield, much quartz and gravel.

Newton township coincides pretty much in its nature with the above described townships: it is very hilly—the gneiss generally prevails—the soil is a light loam, sometimes pretty stiff, and inferior to the adjacent Radnor township. Crum creek generally runs over gneiss.

In Marple and Upper Providence townships, there are more varieties in the soil: the upper part of Providence possesses a stiff black loam; the lower part and Marple, are of a more sandy nature. The farms of the Messrs. Bishops in the upper part have good soil, but wheat is not as sure a crop there as in the lower part, where the soil is more sandy. The average of crop in the upper part is $1\frac{1}{4}$ tons of hay per acre, 40 to 45 bushels of corn, 16 to 17 bushels of rye, 16 to 17 bushels of wheat, 50 bushels of oats: some barley is cultivated, which yields the same quantity as of wheat. The farmers make much use of lime. Here again, the micaceous and quartzose rocks prevail.

The lower part of Providence does not yield such good crops. The average is 10 bushels of wheat, and the same quantity of rye per acre.

I saw here an instance of the disintegration of rocks influencing the soil. Some farmers showed me some spots which they called good ground, but complained much of the stones, which, by every ploughing were turned up. Upon examining these stones, I found that they belonged to the pegmatite, containing kaolin: these stones being for some time exposed to the action of the atmosphere, mouldered soon away to dust —this rendering the soil more tenacious, was probably the cause of the fertility of this soil, as the adjacent spots, in which these stones were not found, were not so fertile. I therefore

advised the farmers to break up the stones, in order to render them less inconvenient in ploughing. Such were the ideas excited, when I examined these soils; but if this be the case, how shall we account for the barrenness of a soil which is nearly entirely composed of feldspar rocks. The white stone, which I have described in the geological part, is of the same nature as the other feldspatic rocks, and the soil which in White Marsh township covers this formation, is in some places nearly destitute of vegetation, and has given to these hills the name of Barren hills.

Moyamensing and Passyunk, two townships forming the peninsula, or the neck inclosed by the rivers Delaware and Schuylkill to the south of Philadelphia, possess an alluvial soil: no rocks are visible there. This alluvion is of two kinds; one, situated below high water mark, being occasionally inundated, is of a marshy nature, and produces only grass; the upper part is of the same nature as the alluvion which I have described to the north of the city, and is admirably calculated for the production of vegetables.

COMPOSITION OF SOIL.

In regard to the constituent parts of the different soils, not much can be said with certainty. In the alluvion which covers our primordial formations, and which seems to have been deposited by the Delaware and Schuylkill rivers, not only every acre gives a different result in chemical analysis, but we had sometimes two or three different ones in a surface not exceeding a square rod. Thus we obtained of a small spot, perhaps no more than one and a quarter acres, which was of a lighter nature than the generality of the soil in Pas-

symk township, (being prepared for raising cabbages and other vegetables for market,) after it had been dried.*

Water - - - - - - - -	20.50
Loose gravel, principally flint, quartz, gray-wack and limestone,† &c. - - -	33.00
Coarse vegetable fibres - - - -	16.00
Fine sand - - - - - -	194.50
The finely divided matter separated by washing and lixiviation, amounted to - - - - -	136.
Being composed of alumina - - -	50.
Silica - - - - - - - -	47.
Carbonate of lime - - - - -	10.
Oxide of iron - - - - -	5.
Animal and vegetable matter - - -	4.
Loss - - - - - - - -	20.
	400.00

An analysis from a parcel taken not more than 20 feet from the former place, and treated in the same manner, and at the same time—gave

Water - - - - - - - -	19.
Gravel, as in the first - - - -	30.
Coarse vegetable fibres - - - -	19.
Fine sand - - - - - -	191.
Fine matter separated by washing - -	141.
Which was composed of alumina - -	52.

* We have in our analyses generally followed the mode recommended by Sir Humphry Davy. The samples were taken upwards of three inches below the surface. They were collected in dry weather, and exposed till they became dry to the touch, and commonly wrapt up in bladders, if they were to remain some time before being subjected to analysis.

† We see from this gravel that this soil was brought on from some distance.

Silica	46.
Carbonate of lime	13.
Oxide of iron	4.
Vegetable matter	4.
Loss	22.

An analysis of a specimen taken upwards of 20 feet from the second, treated in every respect as the former, and at the same time—gave

Water	17.
Gravel, as in the former	31.
Vegetable fibres	20.
Fine sand	195.
Finely divided matter separated by washing	137.
Which gave alumina	51.
Silica	47.
Carbonate of lime	11.
Oxide of iron	4.
Vegetable matter	3.
Loss	21.

A fourth analysis, made of a sample taken upwards of 20 feet from the third, treated as the former—afforded

Water	21.
Gravel, as in the former	33.
Vegetable fibres	15.
Fine sand	195.
Finely divided matter separated by washing	136.
Which was composed of alumina	56.
Silica	40.
Carbonate of lime	9.
Oxide of iron	5.
Vegetable and animal matters	6.
Loss	20.

I found very soon that samples, even taken at a smaller distance than 20 feet from one another, did not give the same result; nevertheless I found, that the changes which the soil of the same field underwent, stood in a certain relation to its constituents.—So it appears from the above analyses, that in proportion as the vegetable fibres increase, a soil seems to be less retentive of water of combination. In the above mentioned analyses, I have been very particular in drying the soils. It was performed in a flat sheet iron pan, placed in a basin filled with water, which was heated to about 115° of Fahrenheit. The different samples were put on the same pan, which, when perfectly dry, was taken out of the hot water, and 400 grains of every parcel was weighed off. These 400 grains were placed again on the same pans, taking care that they remained separate, and were then heated regularly till the vegetable fibres commenced a little to change colour, or approaching to char. During this operation, they underwent the following diminutions.

The first mentioned analysis lost		$20\frac{1}{2}$ grains.
second	do.	19
third	do.	17
fourth	do.	21

We see here a proportion in the quantity of weight lost in these operations, and in the quantity of vegetable contained in the soil: and that in proportion as the quantity of vegetable matter is great, the quantity of water is small. We had in

No. 1.	water	$20\frac{1}{2}$	vegetable matter 16
2.		19	19
3.		17	20
4.		21	15

There exists no uniform proportion in the difference of the other constituents. The above analyses coincide generally with those obtained of soils, which, in Passyunk, are called good soil (sandy loam).

The generality of the alluvion all along the Delaware river, and those of Passyunk, taken not very near the river, where the soil is not influenced by the immediate overflowing of the river, have afforded me on an average 10-12ths coarse matter, principally of silicious sand, and 2-12ths of impalpable matter.

The soil of Moyamensing, or the lower part of the Neck, differs in some respects from the above described, containing less sand and more clay; and it being of a more marshy nature, contains a larger quantity of vegetable matter.

The alluvion which we have to the north of Philadelphia, varies more than that of the Neck. In the vicinity of the city, the soil is too artificial to be taken notice of, being in some places composed of the dirt of the streets of Philadelphia; at least we found fragments of bricks, mortar, or similar substances, sometimes ten or twelve inches below its surface. We have therefore selected our samples upwards of two miles from the city, and have found that, taking the average of several analyses of the alluvion along the Delaware, one-fourth or half a mile from the river, it has given me, of coarse matter of a nature described as at Passyunk, from six-tenths to seven-tenths, and of the fine impalpable matter, from four-tenths to three-tenths, the latter being composed of

Alumina - - - - -	46
Silica - - - - - -	40
Carbonate of lime - - -	3
Oxide of iron - - - -	4
Vegetable and animal matter -	7
	100

These analyses differ very much from those performed with soils taken nearer to the river, where, at some places, it is a mere sand.

The soils situated more distant from the Delaware, particularly those which are called stiff, cold, loamy soils, as in the centre of Oxford, contain very much the same ingredients; but some of them have as much as ten or twelve per cent. of alumina, which quantity characterizes the stiffness of the soils. We found also, that in proportion as we left the Delaware river, the quantity of oxide of iron increased with the increase of clay or alumine, and also the particles of mica; nevertheless there was a limit where this increase ceased. I generally saw that when this mica became more abundant, the clay and iron diminished, and constituted a light sandy soil of a pale colour. Doubtless these changes are produced by the rocks. When clay and iron increased, I generally could see that the soil was influenced by the disintegration of the amphibolic rocks; if, on the contrary, the soil owed partly its origin to the disintegration of the gneiss or mica slate, the quantity of clay and iron became less, and those of mica and sand increased. These changes are sometimes so sudden, and even in one and the same field so frequent, that chemical analyses of soils covering such varieties of rocks as we have between the city and the Limestone valley, are not of much use in ascertaining their nature.

One remarkable fact was experienced during the different analyses which have been made. We did not find in any of the soils the sulphate of lime (plaster of Paris), though analyzed with a view to discover it, particularly one on which a fine crop of clover was growing, and only a short time before we took it, the plaster had been put on.

The soil which was entirely formed by the disintegration of

the rocks, we found rather constant in its constituents, and the chemical analysis alone was sufficient to denote its origin. A soil taken from near the first toll gate on the Ridge road, of a reddish colour and very gravelly, the coarse matter being separated, which was principally feldspar and a few pebbles of quartz. gave by analysis,

Silex - - - - - -	40
Alumine - - - - -	12
Lime - - - - -	10
Iron (per oxide) - - - -	30
Loss by vegetable matter and water	8
	100

These now are nearly the constituents which we, from the pure common amphibole, would expect, and therefore there is no doubt of its being formed by the disintegration of the diabase.

Another soil, from the vicinity of Germantown, gave,

Alumine - - - - -	22
Silex - - - - - -	69
Loss by vegetable matter and water	9
	100

I had separated from this soil the mica, which very much abounds in it, and which floated lightly in the water. We see from this analysis, that its constituents come pretty near to those of the feldspar, and of course was formed by the disintegration of the gneiss and mica slate. If below such soil there is no good subsoil, it is sterile and holds no manure, because the alumine is not in the state of clay, that is, in an impalpable powder combined with some silex and iron oxide, but it is merely in the form of sand, having no cohesion. I found several specimens of such soil, entirely void of vegetable or animal matter.

These two analyses coincide generally, with those obtained from the spots which had all the appearance of having been produced by the rocks; but only a few such places were met with in my excursions, the greater part containing accidental intermixtures, particularly in the lower places, where I found in general a soil bearing much analogy to our alluvion.

I expected to have found some analogy in the analyses of the soils taken from the talc or serpentine formations, with that of the magnesian rocks, or with each other. This was not the case; and we cannot conceive whence it originates, that the soil which covers these rocks is not proper for vegetation. It seems not owing to magnesia, as I imagined before my experiments, because I found some parcels of these soils in which even no trace of it existed; and in those in which I found the magnesia, they contained a mere trifle, sometimes not exceeding more than one and a half per cent. This small proportion, I think, would not influence its fertility, and this is confirmed by an analysis of a soil by Sir Humphry Davy, a soil which he calls "a good, silicious, sandy soil, from a hop garden in Tunbridge, Kent." In this he found 3-400ths of the carbonate of magnesia.

As to the soil of the Limestone valley, this varies also much in its constituents. I found some, after having separated the silicious sand, which amounted to upwards of 81 in the 100, from the finely divided matter, to consist of

Carbonate of lime - - - -	67
Silica - - - - - -	12
Alumina - - - - -	10
Oxide of iron - - - -	3
Vegetable matter - - - -	5
Water - - - - - -	3
	100

In other places, in the same vicinity, the soil giving nearly

the same quantity of finely divided matter, contained no more than three per cent. of carbonate of lime.*

After having ascertained, by numerous analyses, in which the whole of the soil (the coarse gravel only excepted,) was decomposed, that the soil belonged to the disintegration of the feldspatic, amphibolic, or calcareous rocks, I am of opinion, that the generality of the soil of the lands inclosed in our survey, can be divided into four classes, according to their probable origin, viz. 1st, in granitic soil or soils, which probably owe their origin to the disintegration of gneiss, mica slate and pegmatite; to which may be added the soil of the whitestone and serpentine formations. These soils are in general light, and of a sandy nature.

2dly, Amphibolic soil or soils, originating from the decomposition of the amphibolic rocks (diabase). These soils are of a loamy nature, having generally a ferruginous colour, approaching even to brownish red, and containing a large quantity of iron.

3dly, Into limestone soil, being partially produced by the disintegration of limestone; and

4thly, Alluvial soil.

In my survey, the soils of Byberry, Bensalem, part of Moreland, Abingdon, Cheltenham, Springfield, Bristol, Germantown, part of Oxford, part of White Marsh, part of Upper Dublin, part of Roxborough, Penn, Northern Liberties, Ridley, Darby, part of Kingsessing, part of Chester, Providence,

* It seems that the quantity of fine matter which is separated by levigating the soil, constitutes its fertility, and in combination with the vegetable fibres, influences the retentiveness of moisture. When in this part of the soil, the alumine predominates, it constitutes a stiff, loamy soil, of a coherent texture; when the silex predominates, it forms a light, sandy soil, possessing not much cohesion: but this varies so much, even in the same field, that in many cases it is the subsoil alone which contributes to its fertility, and in such cases manure is the only resource to raise a crop.

Newton, Marple, Haverford, Merion and Blockley townships belong, generally speaking, to this first division or granitic soil, a few spots excepted, in which the amphibolic rocks have much modified its nature.

To the second division, that is, the amphibolic soil, belong the townships of Radnor, part of Oxford, part of White Marsh, and part of Roxborough, again, as in the first division, a few spots excepted.

To the limestone soil, or the third division, we refer part of Tredyffin, Upper Merion, Plymouth, Whitpain, part of White Marsh, and part of Upper Dublin townships.

To the fourth, or alluvial soil, belong Moyamensing, Passyunk, and part of all the townships bordering on the Delaware river, and some of those on the Schuylkill. This soil, in fact, we find here or there in every township.

The first class, taking the average from perhaps one hundred samples, which we have examined, from different places in our section, has given 13-16ths of sand and gravel, and 3-16ths of impalpable matter.

Of the second class, the average of numerous trials has given 2-3ds of sand, and 1-3d of impalpable matter.

The limestone soil, or third class, has given 2-10ths of fine impalpable matter, and 8-10ths of sand.

We have seen, speaking of the constituents of the alluvion, that no approximation can be made of the proportion of impalpable matter it contains: some soils containing more than half their weight, while others were wholly destitute of it.

The impalpable part of the granitic soil has given, on an average of thirteen analyses,

Alumina - - - - -	23
Silex - - - - -	64
Loss by water and vegetable matter	13
	100

That of the second, or amphibolic class, has given, on an average of five analyses,

Silex - - - - - -	37
Alumina - - - - -	18
Lime - - - - - -	10
Iron oxide - - - - -	26
Loss by vegetable matter and water	9
	100

That of the limestone soil, or third class, gave

Carbonate of lime - - -	32
Silex - - - - - -	37
Alumina - - - - -	20
Oxide of iron - - - -	4
Loss by vegetable matter and water	7
	100

As to the constituents of the alluvion, we have seen the analyses of the alluvial soils in the beginning of the chemical part of our report. With this some of the most fertile parts of our alluvion coincide; but, as we have already stated, this formation contains many different varieties of soil, some in fact being composed of mere sand, whereas others contain more than three-fourths of impalpable matter, so that nothing can be stated with any degree of certainty of these soils.

EXPLANATORY NOTES.

The rocks spoken of in this report, belong to what generally are called primordial rocks. The gneiss formation, as we have seen, occupies the greatest part of our semicircle. This rock is principally composed of mica,* and granules of compact feldspar.† This gneiss has several trivial names amongst our farmers; sometimes we have heard it called sand rock, sometimes gray flinty rock, and similar names: it often contains quartz, which generally is known amongst country people by the name of white flint. This gneiss, as we have seen in this memoir, contains as subordinate rocks—

(1) Diabase, or Diorite, belonging to the amphibolic rocks. This rock is generally known by the name of greenstone (Grünstein) by mineralogists, and iron rock, pot metal rock, &c. by the farmers. It is composed of amphibole or hornblende, being a black foliated stony substance, and feldspar, as mentioned in the gneiss; in general the amphibole is the predominating part in this rock, which gives it a black appearance and granular structure. When this rock is exposed to the action of the atmospheric air, its black colour changes into a rusty iron hue. We find also gneiss in it.

(2) Pegmatite, also called by mineralogists Petunzée, graphic granite, &c.: it is composed of lamellar feldspar and quartz. This quartz‡ is sometimes so disposed, as to exhibit something resembling Hebraic characters, which has given origin to the name of graphic granite—we find it in the vicinity of Germantown and Wilmington. Sometimes the particles of feldspar and quartz are irregularly mixed, and the feldspar occasionally is earthy, having lost its lamellar structure, and become somewhat friable between the fingers. In that state it forms what is known by the name of

(3) Kaolin, which is used for the fabrication of porcelain, and is also known by the name of Porcelain earth.

(4) Eurite, or Leptinite, Weistein, Klingstein, or Hornfels. This is another feldspatic rock, having somewhat a slaty structure, and contains small glistening points, which I believe to be talc, though foreign mineralogists believe it to be mica, in our formations, and minute crystals of garnet. We find good specimens of this rock near Barren Hill church.

(5) Serpentine is a mixed rock, of a black greenish colour (as it exists in our vicinity), the surface of which, when exposed to the atmosphere, becomes somewhat rusty, as in the amphibolic rocks.

(6) Steatitose Steachiste, is improperly called soapstone in our vicinity. It is a talcose rock, having a somewhat slaty or scaly structure, of a greasy or soapy feel. Being very refractory when exposed to fire, it is generally, under the name of soapstone, used in Philadelphia for the construction of fireplaces.

(7) Phyllade. By this is understood a rock whose base is slate, including several other minerals. In our survey, the phyllade contains numerous varieties of talcose minerals.

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* Mica, commonly called isinglass, being a substance in the form of thin leaves, generally of a half metallic lustre.

† A stony substance, commonly in our vicinity of a whitish gray colour, of a somewhat dull, compact, earthy fracture—it is such as exists in our gneiss. I wish not to be understood as giving a general description of feldspar.

‡ It is the same mineral which I have described in the gneiss; but instead of a granular or compact structure, as in the gneiss, it has in the pegmatite a lamellar structure.

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